AOT & LANSCE The Pulse

July 2010

INSIDE

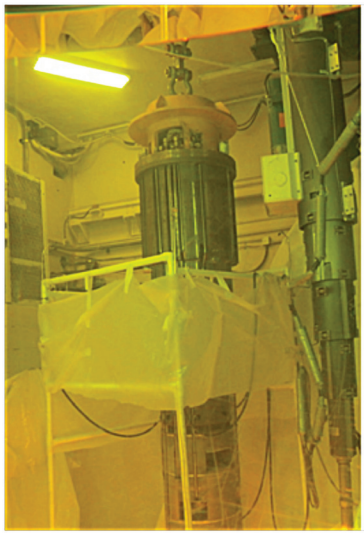
Mark III spallation neutron target completed

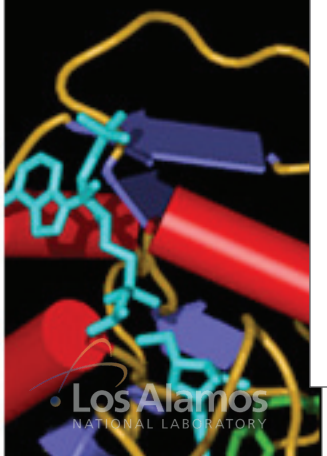
On June 9, shortly after 5 a.m., the first proton beam hit the new "Mark III" spallation neutron target at the Lujan Center. All systems are green and already it is producing higher neutron flux than expected relative to numerical simulations *(see story page 3)*.

Beginning in 2004, the neutronics design for the Mark III was developed by the Spallation Physics Team at the Lujan Center. Guenter Muhrer led the team of Michal Mocko and Charles Kelsey (all LANSCE-LC), with substantial input from the instrument scientists. Researchers performed proof of principle experiments at the Weapons Neutron Research facility in partnership with the Neutron and Nuclear Science (LANSCE-NS), Mechanical Design and Engineering (AOT-MDE), and Accelerator Operations (AOT-OPS) groups. The engineering design was conducted by Joe O'Toole (lead), Tony Gomez, Mike Borden, James O'Hara, Eric Olivas, Ray Valicenti, and Keith Woloshun (AOT-MDE); Mike Baumgartner and Eron Kerstiens (AOT-OPS); Curtt Ammerman, Gretchen Ellis, and Joe Schillig (Mechanical and Thermal Engineering, AET-1); and John Erickson (Accelerator Operations and Techology, AOT-DO).

The new target design (the Mark III target) was installed in April 2010 by a multi-organizational team headed by personnel from the Accelerator Operations and Technology Division.

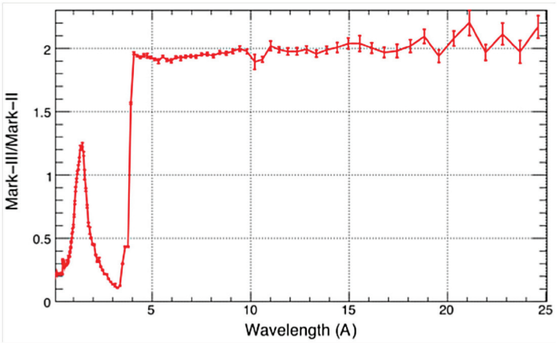
Photos: (Left): Mark II target removal. (Right): Mark III target installation.





continued on page 2

Mark III . . . The Mark III has several innovations promising the highest performance yet, especially for cold neutron wavelengths greater than 4 Ångstroms. Used for reflectometry, small-angle scattering, and magnetism studies, cold neutrons will benefit from a new cold beryllium-reflector-filter that is projected to double the usable cold neutron (long wavelength) flux for three instruments. A gain of up to 10% is expected for the upper-tier liquid-hydrogen moderator as a result of changes in insulating material composition in the target-moderator-reflector system. All the lower-tier moderators, both liquid hydrogen and water, will have "premoderators"—one-to-two-cm slabs of water placed nearby to soak up the excess thermal energy and to reduce high-energy background.



Calculated ratio of the neutron flux provided by the previous-generation (Mark-II) and the current-generation (Mark-III) target system installed at the Lujan Center, plotted as a function of neutron wavelength. The cold neutron flux is projected to increase by up to a factor of 2 for the lower-tier liquid hydrogen moderator.

During the week of June 14, 2010, following the ion source recycle and after the radiation surveys are completed, the shutters for Lujan instruments were opened. Researchers began assessing the neutron beam flux on several instruments. NNSA's Readiness in Technical Base and Facilities (RTBF) program provided $10M funding for the Mark-III project.

Lacerda takes on LANSCE leadership role

Alex H. Lacerda has been selected as the new LANSCE deputy division leader. According to Deputy Associate Director for Experimental Physical Sciences Kurt Schoenberg, Lacerda's extensive experience in low-temperature, high-magnetic field and high-pressure research, along with his strong international connections to many universities and large scientific user facilities will be an important asset for the LANSCE facility management team.

After earning his PhD in low temperature physics from the Universite Joseph Fourier, Grenoble, France, Lacerda joined Los Alamos National Laboratory in 1991 as a postdoctoral fellow in the Condensed .Matter and Thermal Physics group. In December 1992, he joined the National High Magnetic Field Laboratory (NHMFL) as a staff scientist and in 1996, began serving as director of the NHMFL Users Program. In 2004 he was selected as director of the NHMFL and from 2007- 2008, served as acting division leader of the Materials Physics and Application Division.

Mark III outperforming simulations

The new target-moderator-reflector system "Mark III" at the Lujan Center is producing higher neutron flux than expected relative to numerical simulations.

A recent absolute measurement of cold neutron flux at Flight Path-10, where the small-angle scattering instrument low-Q diffractometer (LQD) is sited, shows that the expected gain of about 2x in cold neutron flux is surprisingly 20% higher. This enhancement bodes well for experiments performed on cold-spectrum instruments LQD and its reflectometer cousins Asterix and SPEAR.

The fact that calculations underestimated the actual gain at long wavelengths on the hydrogen moderator is exceptionally good news for users and a delightful mystery for spallation physicists. It may be a surprise to know that the full neutron physics for the target assembly materials is not fully known. Essentially every new target assembly fabricated at spallation neutron facilities across the world breaks new ground, especially at the Lujan Center where innovative design has been the norm. Among the Lujan innovations now copied by others is the split-target flux-trap—a separation of target materials between two tiers with a vacuum in between where the hot spallation neutron gas can be concentrated—and

continued on page 3

Mark III . . . the partially coupled moderator—a way to increase neutron flux dramatically by allowing strong, coupled interchange of neutrons between moderator, reflector, and target components. Gary Russell (retired) and Eric Pitcher (LANSCE-DO) were intellectual leaders of these innovations and had seminal input to the Mark III design team headed by Guenter Muhrer (LANSCE-LC).

In Figure 1, the ratio of Mark-III and the retired Mark-II fluxes measured (red) and calculated (black) for FP-10 shows that extant theory reproduces features at short wavelengths almost exactly. A designed notch in Mark III's flux spectral probability density at 3 angstroms borrows short wavelength neutrons for higher flux at long wavelengths greater than 4 angstroms in order to probe soft matter more comprehensively. That notch, created by a new beryllium reflector-filter added to the liquid hydrogen neutron moderator, is well reproduced by Monte Carlo calculations. The full calculated spectrum for the old and new targets is shown in Figure 2.

Observations at other beam lines at Lujan Center show improved flux with Mark III. Instruments viewing water moderators, optimized for short wavelength neutrons useful in diffraction, are seeing—at a minimum—a return to design-level flux after experiencing a multi-year decay of intensity from the Mark II, apparently due to tungsten target degradation. Preliminary measurements of intensity from Mark III exhibit enhanced flux relative to design on two flight paths, to be confirmed.

One variable that could explain some of the early, promising results is the ortho-para hydrogen ratio in the hydrogen moderator. Because protons are fermions with either spin up (+) or spin down (-), a hydrogen molecule adopts either excited (++) or ground-state (+-) spins; the neutron cross section is 100x higher for the excited ortho-hydrogen state, making it the more efficient moderator. Through natural conversion mediated by interactions between hydrogen molecules and walls, the equilibrium ortho-to-para fraction approaches zero within nine days without beam at 20K. When the beam is on, the steady-state fraction of 25% excited hydrogen is desirable but ill-controlled. Mark-II measurements published by Japanese collaborators in 2006 inferred a steady-state fraction of 35% however that fraction has never been directly measured; there are plans to do so with Mark III in the coming months.

Clever redesign of the Lujan Center target and moderator system has resulted in a cold neutron flux rivaling the highest power pulsed spallation sources in the world while using one-tenth of the proton beam power. The increased cold neutron flux will allow experiments on longer length scales and longer times scales than previously possible. This work was funded by the RTBF program of DOE NNSA and by the Office of Basic Energy Sciences.

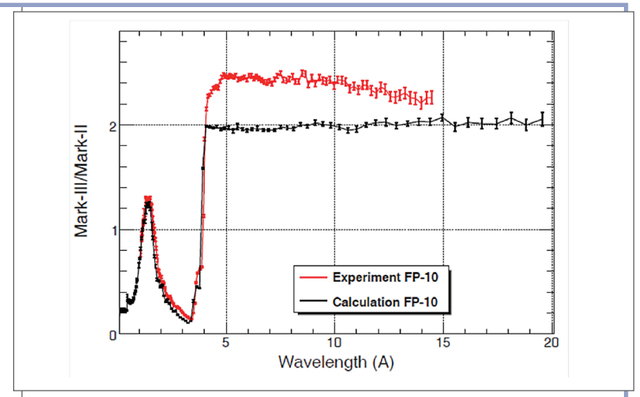


Figure 1. Ratio of neutron flux spectra for Lujan Center's new Mark III target to last year's Mark II target comparing calculated (black) and experimental (red) ratios. The Mark III moderator design optimizes for high flux of cold neutrons with wavelengths greater than 4 angstroms. While Monte Carlo simulations predicted a factor of 2 increase in neutron flux spectral density owing to a new Be reflector-filter, experiment shows a surprising factor of 2.4 owing to unexplained physics of the target assembly.

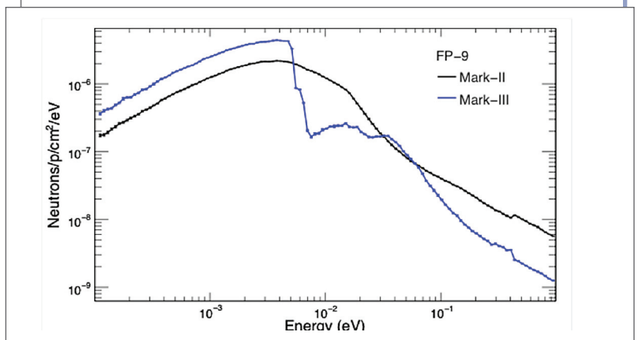


Figure 2. Measured (black) and calculated (blue) neutron spectral densities on the liquid hydrogen moderator serving Flight Path 9 at the Lujan Center.

HeadsUP!

LANSCE and AOT Division members recognized with Pollution Prevention Awards

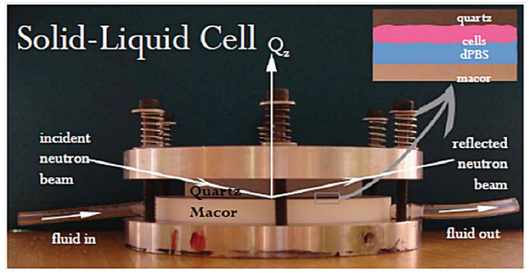
Numerous LANSCE and AOT Division members are recipients of Pollution Prevention Awards for their efforts in pollution prevention and cleanup projects.

The awards recognize individuals or teams whose efforts over the past fiscal year have eliminated or minimized waste or pollution; conserved resources; procured green or environmentally-preferred products; applied sustainable design principles; or identified other ways to reduce risk, save money, and enhance the Laboratory's mission. The members were recently recognized by the Laboratory, along with more than 300 awardees for their efforts on 60 pollution prevention and cleanout projects.

Cleaning 101 for physicists

Jaroslaw Majewski, Michael Jablin (LANSCE-LC); Frances Aull (HIS-IS)

The new procedure eliminates the use of a corrosive chemical to clean instrumentation. The optical instrumentation, which had been cleaned with nitric and hydrochloric acids, is now returned to the manufacturer for mechanical polishing. This new procedure not only eliminated the purchase, use, and disposal costs, but also eliminated safety issues associated with using the acids.



Recycled capacitors save money and the environment

Gerald Bolme, Karen Young, Alex Velasquez (AOT-RFE); Patricia Vardaro-Charles (ENV-ES); Michael Baumgartner (AOT-OPS)

LANSCE recycled 258 capacitors containing 970 gallons of oil. The capacitors were no longer needed at the accelerator, but required regular safety and environmental inspections. A specialized contractor was hired to safely and efficiently recycle the capacitors and the oil. While the recycling cost $32,000, the project realized a labor and cost savings of almost $35,000 and decreased the Laboratory's safety and environmental liabilities.

Paint can prevent spills

Alex Velasquez, Gerald Bolme, Karen Young (AOT-RFE); Kelly Gee (MSS-LFO); Patricia Vardaro-Charles (ENV-ES); Michael Baumgartner (AOT-OPS); Doug Salazar (MSS-FEW)

The paint on the inside of secondary containment units at LANSCE was deteriorating and clogging the units' drains, rendering them non‑functional. To prevent a regulatory finding or violation, the inside of the units were cleaned and repainted by Crafts personnel; this activity ensured that spills and clean up wastes are avoided.

Sealant saves the day

Alex Velasquez, Gerald Bolme, Karen Young (AOT-RFE); Patricia Vardaro-Charles (ENV-ES); Michael Baumgartner (AOT-OPS); Bryan Stinnett and Jim Hackett

Regulatory concerns were triggered when several leaking, aging pieces of electrical power equipment were discovered at LANSCE. A subcontractor was able to repair the leaks using an injectable sealant while the units were still online. The repairs avoided maintenance downtime, extended the life of the units, and eliminated pollution and associated environmental and regulatory issues.

continued on page 5

Heads UP…Major cleanup operations avoided

Michael Baumgartner (AOT-OPS); Karen Young (AOT-RFE); Henry Alvestad (AOT-ABS); Mark Haagenstad (ENV-RCRA); Patricia Vardaro-Charles (ENV-ES); and Doug Salazar (MSS-FEW)

Technical Area 53 developed and implemented a new spill prevention plan that evaluated the condition of 131 pieces of equipment and installed secondary containment devices where needed. The benefits included the containment of potential oil releases and the prevention of subsequent cleanup operations and possible regulatory violations.

In with the new, out with the old

Tsuyoshi Tajima, Felix Olivas, John Chamberlin (AOT-MDE); John Harrison (IAT-2); Ronnie Garcia (WES-WGS)

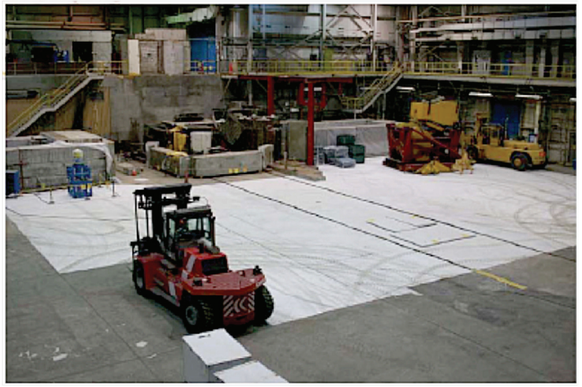
LANSCE's accelerator's vacuum system relied on aging ion pumps that had exceeded their life expectancy. The annual cost of reconditioning these pumps was significant due to waste disposal fees and labor. Replacing the aging ion pump components increased reliability, reduced unplanned maintenance cost, reduced hazardous waste disposal costs, reduced regulatory liability, and reduced worker safety issues related to chemical exposures.

A new materials test station doesn't mean extra waste

Jeffrey Hannaford, John Eddleman, James Abernathey (AOT-MDE); Patricia Vardaro-Charles (ENV-ES); John Ireland (SPO-CNP); Chris Quartieri (PMF-WEP); Brett Cummins, Nicholas Apodaca, Lance Kloefkorn, Ronnie Garcia (WES-WGS); Tanya Salazar (RP-1); Michael Dennis (IHS-IS); Darrik Stafford (SP-DISP); Darril Stafford (CM-STRS)

The new Materials Test Station project at LANSCE prevented pollution by incorporating significant waste avoidance practices. During the planning phase, materials and equipment were identified to maximize metal recycling opportunities. Throughout the project, millions of dollars were saved in disposal costs.

Experimental Area A filled with legacy experimental equipment



Experimental Area A now.

Out with the old

William Reass, Dana Netz, Dan Rees, Joe Bradley, Matthew Fresquez, Louis Fernandez (AOT-RFE); Lance Kloefkorn (WES-WGS); Damian Romero (ASM-PM)

Items stored in two, aging transportainers at Technical Area 53 were biologically decontaminated, evaluated for usefulness, and dispositioned accordingly. Several of the items were put back into circulation for use, recycled, or properly disposed of. As a result of this effort, the organization reduced its footprint; a hanta virus risk was eliminated; an aging structure was salvaged; needed equipment was placed back into use; 10,000 pounds of metal was recycled; and we avoided sending 180 cubic feet of material to a landfill.

Legacy equipment clean-up

Lawrence Quintana, James Knudson, Stephen Morgan, Eron Kerstiens, Michael McCormick (AOT-OPS)

The 1L Target Team at LANSCE needed to move to a new location in support of operations. The move required the Team to relocate to an area approximately half the size of their existing space. In an effort to streamline the move and make the new location habitable, the team identified non-essential equipment for salvage or recycling and leveraged a subcontractor to dispose of additional items. The move resulted in the recycling of a large amount of metal and electronics equipment and the reuse of excess office furniture.

continued on page 6

Heads UP.... Shrinking shoe sizes and footprint reduction MDE

Victor Vigil, Claude Conner, Brandon Roller (AOT-MDE); Damian Romero (ASM-PM)

Two transportainers containing a truckload of furniture, office cabinets and mechanical equipment had been exposed to weather and mice due to corroded roofs. By cleaning out, decontaminating and dispositioning, or salvaging the contents of the transportainers, employees reduced the footprint of Technical Area 53, eliminated a hanta virus risk, and avoided approximately $1,500 in landfill disposal costs.

Cleanup part deux

Linda Zwick, Kevin Jones, Jean Trujillo (AOT-DO); Daryl Jones (PS-4); Ginger Grant (LANSCE-DO); John Graham (ADESHQ); Kristy Keane (LFO-DO)

The first phase of the cleanup of the basement at Technical Area 53 conducted in 2008 left materials needing to be hand-sorted. During the second phase of the cleanout, management and Division-level personnel sifted through these materials to determine their historical or archival significance. Approximately 100 boxes of paper and other media were prepared for archiving or provided to the appropriate group for proper dispositioning. This cleanout recycled a large amount of paper and other office supplies while lowering the fire load in the building.

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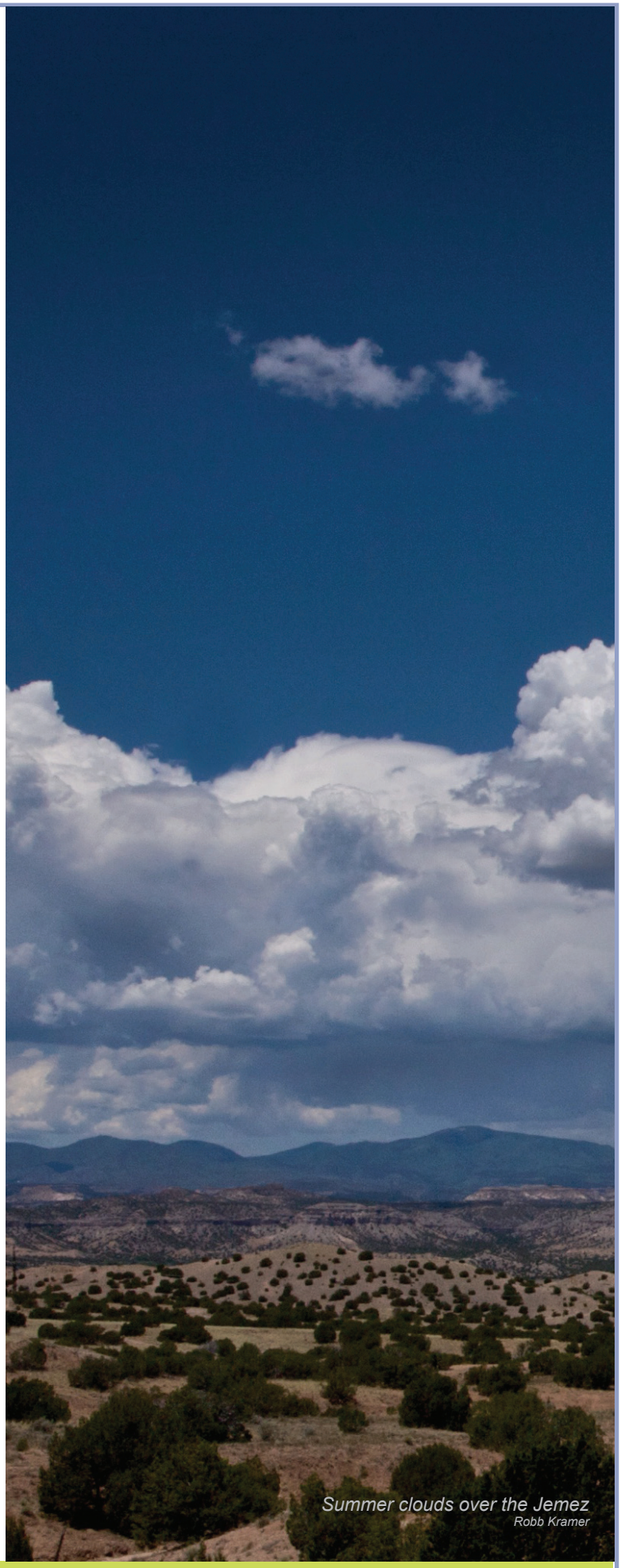

Summer clouds over the Jemez
Robb Kramer